Total No. of printed pages = 4

EE 181107

Roll No. of candidate 1612123

2023

B.Tech 1st Semester End-Term Examination

BASIC ELECTRICAL ENGINEERING

(New Regulation and New Syllabus)

Full Marks – 70 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1. Choose the correct answers from the following : (10 × 1 = 10)

(i) Superposition theorem can be applied only to

(a) linear network (b) non-linear network

(c) linear bilateral network (d) bilateral network

(ii) In Thevenin's theorem equivalent resistance (Thevenin's resistance) is determined by

(a) short circuiting all independent current and voltage sources

(b) open circuiting all independent current and voltage sources

(c) short circuiting all independent voltage sources and open circuiting all independent current sources

(d) open circuiting all independent voltage sources and short circuiting all independent current sources

(iii) An alternating current is given by $i(t) = 20 \sin (314t + 60°)$ ampere. The rms value and frequency of the current are

(a) 20 A, 50 Hz (b) 20 A, 314 Hz

(c) 14.14 A, 314 Hz (d) 14.14 A, 50 Hz

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(iv) The active power in a single-phase AC circuit of voltage V and current I is given by

(a) VI (b) VI sin ϕ

(c) VI cos ϕ (d) $VI^2 \cos \phi$

(v) A small capacitance is added to a highly inductive circuit, then

(a) phase angle between voltage and current will increase

(b) the phase angle between voltage and current will decrease

(c) the phase angle will remain same

(d) the power drawn by the circuit will decrease

(vi) The relationship between back emf (E_b) and applied voltage (V) in case of a DC motor of armature current (I_a) and armature resistance R_a is given as

(a) $E_b = V - I_a R_a$ (b) $E_b = V + I_a R_a$

(c) $E_b = V$ (d) $E_b = V/2$

(vii) For an ideal transformer the windings should have

(a) maximum resistance on primary side and least resistance on secondary side

(b) least resistance on primary side and maximum resistance on secondary side

(c) equal resistance on primary and secondary sides

(d) no ohmic resistance on either side.

(viii) For induction motor normally

(a) the stator winding is connected to AC supply and the rotor winding is short-circuited

(b) the rotor winding is connected to AC supply and the stator winding is short-circuited

(c) both of the stator and rotor windings are connected to AC supply

(d) stator winding is connected to AC supply and the rotor winding to DC supply.

(ix) The pointer or moving system of indicating instrument returns to its zero position on removing the source producing the deflecting torque. This happens due to

(a) mass of pointer (b) damping torque

(c) controlling torque (d) balancing torque.

(x) If a voltmeter is connected, like an ammeter, in series with the load

(a) the measured reading will be too high

(b) almost no current will flow in the circuit

(c) the meter will burn out

(d) an inadmissibly high current will flow

2. (a) Determine current in branch AB of 10 ohm resistance in Fig. 1 using superposition theorem. (8)

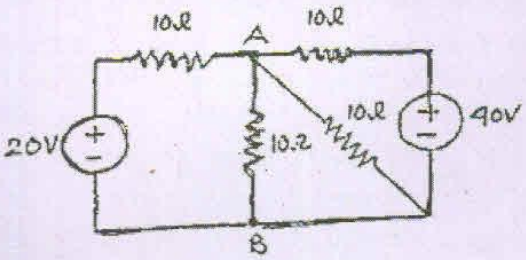

Fig. 1

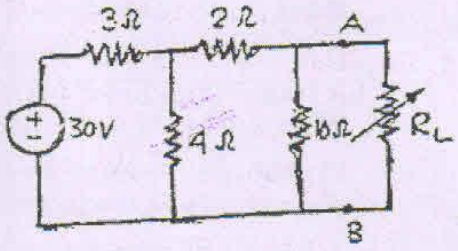

Fig. 2

(b) Apply Network theorems in the circuit shown in Fig. 2 to determine the value of R_L that will draw maximum power. Also determine this power. (7)

3. (a) Find the maximum value, rms value, phase, time period and frequency of the sinusoid: (5)

$i(t) = 1.8 \cos (500\, t + 10°)$. Also plot the sinusoid.

(b) The voltage applied to a 200 microfarad capacitor is

$v(t) = 5 \sin (2500\, t - 30°)$. Find the current passing through the capacitor. (5)

(c) A choke coil of resistance R and inductance 26.7 mH is connected in series with 10 ohm resistance. The voltage measured across 10 ohm resistance is 20 V and across the coil is 22.4 V. If the supply voltage frequency is 60 Hz, determine the value of resistance R, impedance and power factor of the circuit. Also draw the phasor diagram. (5)

4. (a) A series R-L-C circuit has resistance R = 20 ohm, inductance L = 100 mH and a capacitance C = 200 microfarad. A voltage of 230 V, 50 Hz is applied to the circuit. Determine impedance of the circuit, rms value of total current, power factor, active and reactive power. Also draw the phasor diagram. (5)

(b) A two branch parallel circuit with branch impedance $Z_1 = 10.6 < 20°$, $Z_2 = 14.14 < 45°$ has an applied voltage $V = 170 < 45°$. Determine branch admittance and total admittance. Using admittance data, calculate total current. (Bold letters indicate phasor quantities). (5)

(c) A balanced star-connected load of impedance Z ohm/phase is connected to a three- phase 400 V, 50 Hz supply. If the line current is 20 A, and power taken by the 3-phase load is 12 kW, determine resistance and reactance of the load in each phase. (5)

5. (a) What is meant by an ideal transformer? Can it be physically realized? (3)

(b) How copper loss is different from iron loss (core loss) in a transformer? A transformer has copper loss of 800 W and iron loss of 500 W at full load. What will be the copper loss and iron loss at half load? (4)

(c) Explain the working principle of DC motor. Draw the equivalent circuit diagram of a dc shunt motor. (5)

(d) A 230 V, DC shunt motor takes a current of 40 A and runs at 1100 rpm. If armature and shunt field resistances are 0.25 ohm and 230 ohm respectively, find the torque developed by the armature. (3)

6. (a) What is synchronous speed of a three phase induction motor? Determine the synchronous speed of a 3-phase, 6-pole, 440 V, 50 Hz induction motor. (4)

(b) Mention some household appliances or electrical machineries where single-phase and three-phase induction motors are used. (3)

(c) State two basic differences between single-phase and three-phase induction motor. (2)

(d) Explain the necessity of deflecting torque, controlling torque and damping torque in an indicating instrument. (4)

(e) What are shunt and multipliers? (2)

7. (a) A moving iron instrument has a resistance of 0.6 ohm and a full scale deflection current of 0.1 A. A shunt is connected to convert this instrument into an ammeter for measurement of current of 0-15 A. Determine the value of shunt resistance. (4)

(b) What are the different types of cables used in internal wiring? (3)

(c) What is meant by earthing? What various methods are adopted for earthing and which one is the most common and suitable? (3)

(d) Draw wiring diagram of a circuit consisting one lamp and one fan (with regulator) outlet which are controlled by individual switches. (5)
